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# Combat simulation modeling in Naval Special Warfare mission planning

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# NAVAL POSTGRADUATE SCHOOL
# MONTEREY, CALIFORNIA

# THESIS

**COMBAT SIMULATION MODELING**
**IN**
**NAVAL SPECIAL WARFARE**
**MISSION PLANNING**

by

Jeffrey W. Hakala

December, 1995

Thesis Advisor: Bard Mansager



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This thesis describes the processes involved in modeling and simulation and discusses how the stochastic nature of simulation is particularly relevant to combat. Deliberate, Time-sensitive, and Dynamic mission planning are described and the commonality of tactical planning in each instance is established. Based on this framework, a notional SEAL scenario is used to illustrate the role of simulation in each type of mission planning, focusing primarily at the tactical level. The thesis concludes by discussing additional applications of combat simulation modeling within the Naval Special Warfare community and makes recommendations for its effective and efficient implementation.

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# COMBAT SIMULATION MODELING IN NAVAL SPECIAL WARFARE MISSION PLANNING


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## ABSTRACT

This thesis explores the potential role of combat simulation modeling in the Naval Special Warfare mission planning cycle. It discusses methods for bridging the gap between the simulation and mission planning processes, addressing strengths and weaknesses as well as employment considerations.

This thesis describes the processes involved in modeling and simulation and discusses how the stochastic nature of simulation is particularly relevant to combat. Deliberate, Time-sensitive, and Dynamic mission planning are described and the commonality of tactical planning in each instance is established. Based on this framework, a notional SEAL scenario is used to illustrate the role of simulation in each type of mission planning, focusing primarily at the tactical level. The thesis concludes by discussing additional applications of combat simulation modeling within the Naval Special Warfare community and makes recommendations for its effective and efficient implementation.

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## EXECUTIVE SUMMARY

Special Operations Forces (SOF) are unique because they provide the National Command Authority (NCA) with a broad range of capabilities that can be of great utility across the operational continuum. SOF are particularly useful as an instrument of national power when the international circumstances call for a US military response less than the commitment of conventional military forces.[1] Today's changing world order, with untold numbers of small ongoing conflicts, may increasingly require the use of SOF.

The virtual omnipresence of the media and their apparent fascination with SOF assures publicity regardless of the results of a special operation (SO). Negative, skewed, or uninformed publicity often equates to a degree of negative public opinion towards military operations, SO in particular. This, in turn, may cause decision makers to shy away from military force regardless of its potential value in a given situation. In order to avoid this predicament, SOF must utilize any and all resources available to maximize their effectiveness and to assure both political and military decision-makers a high probability of success prior to employment.

This thesis explores the potential role of combat simulation modeling in the Naval Special Warfare (NSW) mission planning cycle. It seeks to provide an understanding of the processes involved in simulation and how they can benefit Navy SOF during deliberate, time-sensitive, and dynamic mission planning, concentrating on the tactical planning inherent to all three. It also addresses additional roles for simulation within the NSW community.

Simulation, according to Webster, is to give a false indication or appearance of; feign; pretend. It is a form of mathematical modeling which, as its definition may indicate, often carries with it a derogatory inference. Yet the prohibitive costs associated with experimental constructs underscore the need to search for indirect methods to study real

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[1] Joint Chiefs of Staff, Joint Pub 3-05.3: Joint Special Operations Operational Procedures, Washington D.C.: The Joint Chiefs of Staff, 1993.

world phenomenon, such as a SEAL combat mission. The mathematical modeling process is such a method and consists of the following steps:

1. Given some real world system or behavior, make observations and gather sufficient information to formulate a model.
2. Analyze the factors influencing the model and reach mathematical conclusions.
3. Interpret the model and make predictions or offer explanations.
4. Test the conclusions about the real-world system.[2]

Simulation models involve computers which have the capacity to store parameters associated with the real-world system and to generate a simulated environment through algorithms and functions. Output data are then produced for analysis and interpretation.

The Monte Carlo, or stochastic simulation, is probabilistic in nature using random number generation to determine the final outcome of a particular event. This randomness is particularly relevant to combat, where the slightest variation in any number of factors may change the outcome. Determining the potential impact of these various outcomes during the mission planning process will allow for more efficient prior planning and increase the probability of mission success.

This thesis explores the three types of mission planning conducted by Navy SOF - deliberate, time-sensitive, and dynamic, and discusses the "strategic" application of simulation during each. Deliberate planning is planning for a hypothetical situation involving the deployment and employment of apportioned forces and resources projected to be available. It offers the greatest opportunity to utilize simulation as time constraints are less of a factor. Multiple enemy threat packages can be created and plans developed for each. Rehearsals can first be run on a simulation to determine their viability before expending resources with actual rehearsals.

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[2] Giordano, Frank R. & Weir, Maurice, D. A First Course in Mathematical Modeling, Monterey: Brooks/Cole Publishing Company, 1985.

Simulation may, however, offer the greatest utility during time-sensitive planning which is planning for the deployment and employment of allocated forces that occurs in response to an actual situation. In Time-sensitive planning, rehearsal time may vary from limited to non-existent. While rehearsal on a simulation cannot replace actual rehearsals, and cannot provide the answer to what will happen in a given set of circumstances, it can provide awareness of contingencies or critical nodes which may occur and will allow for some degree of planning to take place prior to deployment.

Dynamic mission planning at the tactical level is not formalized in doctrine. Occurring during a conflict where there is a lag in employment, tactical elements and their supporting planners analyze the commander's intent for the area of operations and generate Mission Concepts (MICONs) without having received a mission tasking (MITASK). Simulation can aid in the target selection process as well as in determining the impact and priority of individual MICONs.

The commonality of tactical planning during the three type of planning discussed leads to a role for simulation which spans the planning spectrum. By developing a notional SEAL scenario for illustrative purposes, this thesis discusses the possible uses for simulation during the tactical or execution planning phase of an operation. Route planning, synchronization, weapon selection, and threat locations are examples. While there is potential for quantitative analysis of mission success, detection probability, and so forth, the power of simulation lies more in its ability to make conditional predictions and aid planners in considering these predictions. This counterweights the common tendency to select the desired option in the face of indications to the contrary.

This thesis also discusses additional roles for simulation in the NSW community including:

-Database for enemy and friendly system characteristics

-Situation map for exercises and real-world operations

-Briefing and debriefing tool

-Scenario developer

-Gaming platform

There are several employment considerations which must be addressed to aid in the efficient and effective implementation of simulation in the NSW community including hardware/software issues, database creation and management, terrain files and the identification and training of potential users. Implementation of simulation in the NSW community can be accomplished with a minimum expenditure of resources, while its use should provide cost efficient beneficial results. Naval Special Warfare mission planning and mission planners are already highly refined, and while simulation may only provide a small qualitative increase in a plan, that increase may mean the difference between success and failure in a special operation.

# I. INTRODUCTION

Special Operations Forces (SOF) are unique because they provide the National Command Authority (NCA) a broad range of capabilities that can be of great utility across the operational continuum. SOF are particularly useful as an instrument of national power when international circumstances call for a US military response less than the commitment of conventional military forces.[1] Today's changing world order, with untold numbers of small ongoing conflicts, may increasingly require the use of SOF.

The current political environment, however, is unforgiving. As special operations (SO) are generally connected to high political aims and thus highly visible, the accepted margin for error is small. There are rarely large campaigns that can conceal individual mission failures. Furthermore, mission failures may equate to combat losses. While the undesirability of human loss goes without saying, there is the additional factor of the expense and training time invested in a SOF operator.

The virtual omnipresence of the media and their apparent fascination with SOF assures publicity regardless of the mission results. Negative, skewed, or uninformed publicity often equates to a degree of negative public opinion towards military operations, SO in particular. This, in turn, may cause decision makers to shy away from military force regardless of its potential value in a given situation. In order to avoid this predicament, SOF must utilize any and all resources available to maximize their effectiveness and to assure both political and military decision makers a high probability of success prior to employment.

According to Joint Pub 3-05.3, successful SO depend upon three factors: clear national and theater strategic objectives; effective command, control, communications, computing and intelligence (C4I) and support at the operational level; and competent tactical planning and execution. For the SOF operator, tactical planning and execution are their

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[1] Joint Chiefs of Staff. Joint Pub 3-05.3: Joint Special Operations Operational Procedures, Washington D.C.: The Joint Chiefs of Staff, 1993.

primary contribution to mission success. The most visible of these aspects to the political and military decision-maker is mission planning. The thoroughness and tactical soundness of a plan presented by SOF during the planning process will impact greatly on the ultimate employment decision. To this end, mission planning capabilities must be maximized.

Combat simulation modeling (CSM) offers SOF planners a tool which can provide valuable information not only to the combat troops but also to decision-makers; political and military leaders will have more complete information on which to base employment decisions. Army Special Forces A-teams conducting their Joint Readiness Training Center (JRTC) rotations are beginning to include mission planning on the Janus combat simulation with analysts from the Fort Bragg Simulation Center prior to mission execution. This action is in its infancy, but results have been promising.[2] While simulation has been present in the military services for decades, it has found limited use by ground based SOF planners and operators. The technological advances in simulation software, combined with readily available and increasingly low cost hardware indicate an opportune time for SOF operators to further utilize CSM in mission planning.

## A. OBJECTIVES

This thesis will focus on CSM in the Naval Special Warfare (NSW) mission planning process, rather than SOF as a whole. Differences in missions, types and methods of training, and strategies and techniques during the planning process require a more focused approach. The concept described, however, is applicable to other SOF units as well.

There are three fundamental objectives to this research. First, to identify the specific contributions combat simulation modeling can provide to the NSW mission planning process. The applicability of CSM will be assessed using a level of analysis commensurate with a mission planning agent (MPA). Joint Publication 3-05.5 defines the MPA as the subordinate special operations force commander designated by the joint force special

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[2] Based on After Action Reports (AAR's) sent by John Wood from the Fort Bragg Simulation Center. Copies available.

operations component commander to validate, plan, and execute a particular special operations mission. For NSW this will likely equate to a Naval Special Warfare Task Unit or Task Group (NSWTU/TG), and will incorporate staff planners as well as operational forces, including, whenever possible, the forces designated to execute the mission. The focus of the thesis will be on tactical and operational applications, and the ability of CSM to aid the MPA in developing and evaluating thorough, tactically sound plans.

The second objective is to analyze and recommend procedures for employment of CSM by both a MPA and the NSW community in general. This analysis will be limited to requirements for efficient operation of a simulation, but will not address procurement issues.

The final objective is to identify key SOF, and more specifically NSW elements which are not presently modeled in any simulation. Efforts are currently being made to create an NSW mission planning module which would include a tactical level simulation. Since there is no currently accepted "SOF model", identifying essential requirements should provide a tool to aid in the assessment of prospective simulations or in the design of future simulations.

A recurring theme will be stressed throughout this thesis. While there is a great deal of time and effort expended in creating detailed simulation models, they are still a simplification. It is unrealistic to think that they can account for every possible detail. However, an insightful analyst who is knowledgeable about the algorithms and functions which are modeled within a simulation can use this fact to his advantage during the planning process. Knowing which details of a combat mission are modeled and which are not, forces an analyst to consider this fact as it pertains to the planning being conducted. A detail which is not present in the model, but is deemed important for consideration not only identifies a possible shortfall in the simulation, but a possible critical node or essential element of information (EEI) for the mission itself.

The purpose of this thesis is <u>not</u> to quantitatively analyze any aspect of mission planning. Hypotheses will not be subjected to rigorous statistical analysis in order to determine significance. This thesis is intended as a stepping stone towards implementation

of CSM in the NSW mission planning process and should provide a recipe for its effective application.

## B. RESEARCH DESIGN AND METHODOLOGY

The research design begins with an investigation of the mathematical modeling process and its role in simulation. This will be followed by a discussion of the characteristics, capabilities, and limitations of CSM. Subsequently, both the general SOF and more specific NSW mission planning processes will be investigated with the intent of identifying subject areas for application of CSM. The main focus of the research will be to bridge the gap between the concept of simulation modeling and the mission planning process. This will be achieved by utilizing the Janus(A) High Resolution Combat Model (Janus) to explain and demonstrate the applicability of CSM in contributing to the NSW planning process

The Janus simulation was selected for purely practical purposes, as it is readily available at the Naval Postgraduate School. Janus does, however, contain the basic characteristics and capabilities found in most of the prevalent simulations in the military community, and has proven itself effective in the Army since 1973. Furthermore, the Joint Conflict Model (JCM) and the Joint Tactical Simulation (JTS) are Janus derivatives. These simulations are either in use or development by the United States Special Operations Command (USSOCOM), and will be discussed in more detail in Chapter V.

The drawbacks in using Janus will also be addressed. The fact that it is a ground combat simulation designed for battalion to brigade size operations make it less than ideal for NSW purposes in that the human element is not modeled with great detail. Understanding these limitations is important, but they by no means limit the validity of this research. This thesis focuses on the applicability of CSM in general. Janus will be used as a reference for discussion and illustration of specific points concerning simulation in mission planning. Furthermore, these limitations will be addressed later in the context of necessary characteristics for a SOF specific model.

Janus will be applied in two distinct manners. First, Janus capabilities will be discussed in the context of aiding in the planning categories previously identified. Methods of employment and potential benefits and drawbacks to the use of CSM in the NSW mission planning process will be addressed. Second, utilizing a notional scenario designed for illustrative purposes, Janus will be used for the development and analysis of courses of action (COAs) as would occur in a normal mission planning situation. The results of this application of Janus will provide the resources necessary to recommend appropriate application of CSM to NSW mission planning, as well as to identify necessary additions to a SOF specific combat model.

## C. ORGANIZATION

This thesis is divided into five chapters including the introduction. Chapter II provides a brief historical background of simulation in the military followed by a cursory description of the mathematical process of modeling and the stochastic nature of simulation. This chapter will also identify capabilities and limitations of CSM with specific reference to the Janus model. Chapter III discusses the SOF doctrine for mission planning and NSW specific approaches. Chapter IV is the heart of the research with a discussion of the actual application of Janus to the NSW mission planning process, first at the strategic level followed by its practical application to a notional SEAL scenario. Chapter V contains a discussion of alternative roles for simulation in the NSW community, other SOCOM models, employment considerations, conclusions and recommendations.

# II. MODELING AND SIMULATION

Modeling and simulation have a long history of application in military circles. While simulation began as a practical exercise rather than computer based, technological advancements soon created new tools. Today, modeling and simulation are used extensively, from analyzing supply and budget trends to conducting major Command Post Exercises using computer simulation driven scenarios.

## A. MODELING

An understanding of mathematical modeling and the processes involved in simulation will assist in determining the applicability of CSM to NSW mission planning. According to Giordano and Weir, a mathematical model is a mathematical construct designed to study a particular real world system or phenomenon. Use of a model may make it possible to predict the future behavior of the phenomenon and analyze the effects various situations have on it.

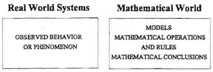


**Figure 1**. Mathematical Modeling

It is very important to realize, however, that the results derived from a mathematical model are mathematical conclusions as indicated in Figure 1. The value of the results is limited to the accuracy of the model used. For this reason, as will be discussed later, the algorithms used in a simulation must be accessible to analysts and understood so that they may be validated and adjusted as necessary.

The alternative to a model is for an analyst to create a real world test or experiment and observe the effects on the real world behavior. There are many situations, however, where the costs of such a course for even a single experiment are unacceptable. For example, determining the dosage at which a particular drug becomes fatal or studying the radiation fallout effects should the San Onofre nuclear power plant experience an accident. In preparation for or during actual combat, training and rehearsals for a particular mission can be conducted as time and resources permit. While placing friendly forces in opposing roles is the most valuable and realistic form of simulating the enemy, it can attain only a limited level of realism. Individuals are not threatened by actual adversaries with weapons, and actions by both sides are limited by safety constraints.

These prohibitive costs underscore the need to search for indirect methods to study real world systems or phenomenon, such as a SEAL combat mission. The mathematical modeling process, as depicted in Figure 2, is such a method and consists of the following steps:

1. Given some real world system or behavior, make observations and gather sufficient information to formulate a model.
2. Analyze the factors influencing the model and reach mathematical conclusions.
3. Interpret the model and make predictions or offer explanations.
4. Test the conclusions about the real-world system.

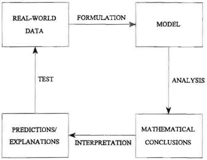


**Figure 2.** The Modeling Process

There are different types of models which serve various purposes. Mathematical models include graphical, symbolic, simulation and experimental constructs. Trajectory plots of various mortar rounds are an example of a graphical model. A symbolic model may be a formula, system of equations, or a miniature replication of a real-world object like a spacecraft. The lack of opportunity to utilize experimental constructs, for the reasons previously discussed, gives way to simulation modeling.

## B. SIMULATION

Simulation generally has a derogatory inference in everyday usage, which is understandable given Webster's definition of the term simulate - to give a false indication or appearance of; pretend; feign. Yet the value of simulators in training pilots was realized long ago. A primary reason for the negative view of simulation is a lack of knowledge on the part of potential users. The purpose of this section is to provide a basic understanding and appreciation of the simulation process.

A behavior being modeled is either deterministic or probabilistic. Processes with an element of chance involved, such as the rolling of dice, are probabilistic. Determining the area under a curve, while it may be impossible to find precisely, is deterministic. The strength of a high resolution simulation model, at the system level, is its ability to model probabilistic behavior, providing users with an analysis tool otherwise unavailable.

Simulation models involve computers having the capacity to store parameters associated with the real-world system and to generate a simulated environment through algorithms and functions. Output data is then produced for analysis and interpretation. One of the most common types of simulation and the type found in most military computer simulations, is the Monte Carlo process.

### 1. Strengths

The principle advantage of the Monte Carlo simulation is the relative ease with which it can be used to model very complex probabilistic behaviors, such as combat. Furthermore, it can provide performance estimations over a wide range of conditions rather than a restricted range as often required by an analytical model. A combat simulation model is a perfect example. A SEAL mission can be executed as a stand alone mission against a single target or as part of a large scale joint operation. Additionally, since submodels within the simulation can be altered with relative ease, there is the potential of conducting a sensitivity analysis. For example, if successive runs of a specific SEAL mission in a large joint operation continually yield a certain result, various submodels can be altered, such as the characteristics of a close air support (CAS) flight, to determine the effects of different CAS alternatives. Critical nodes during a mission may be identified during this process allowing for prior planning. Finally, the modeler has control over the level of detail in a simulation. For example, a three day mission can be compressed in time or a ten minute time on target expanded, giving a great advantage over experimental models.

### 2. Weaknesses

The probabilistic nature of a Monte Carlo simulation limits the conclusions that can be drawn from a single run, unless a sensitivity analysis is conducted. Such an analysis often requires many more runs just to consider a small number of combinations of conditions that can occur in the various submodels. This limitation then forces the modeler to estimate which combinations might occur for a particular set of conditions. While this is a limitation of simulation, it is largely accounted for by the planning process itself, where intelligence estimates combine with tactical planning to create best guess situations.

Furthermore, even though a simulation may correctly identify which of the various alternatives tested seems best, it still cannot provide an optimal solution because it cannot consider all possible alternatives. This means that considerable judgement is required to determine which alternatives to simulate. Once again, simulation should not and can not take the place of common sense and standard mission planning procedures. The considerable judgement used to determine which alternatives to consider is part of the mission planning process regardless of whether simulation is utilized.

Understanding the inherent weaknesses in simulation is necessary in order to take full advantage of the inherent strengths. Simulation does not provide "the answer", only prospective "answers" with insight into their value. There is a danger in placing too much confidence in the predictions resulting from a simulation, especially if the assumptions present in the simulation are not clearly stated. Furthermore, the appearance of using large amounts of data and computer time, combined with the fact that a layman can easily understand a simulation model and the computer output often leads to overconfidence in the results.

## C. THE STOCHASTIC PROCESS

The Monte Carlo simulation is generally considered synonymous with stochastic simulation, meaning there is an element of randomness to the outcome of a particular event.

This randomness is the source of much consternation in the mathematical community. Unfortunately, many of the so-called random functions supplied with computers are far from random, and many simulation studies have been invalidated as a consequence.

Take for example the following seemingly random sequence

13, 8, 1, 2, 11, 14, 7, 12, 13, 12, 17, 2, 11, 10, 3

It is actually generated by the simple deterministic rule $X_i = X_{i-1} + X_{i-2} + X_{i-3}$, MOD 20, and the sequence repeats after 248 terms.[3] Although it appears random, and its solution eludes even the best minds in mathematics, it may not be suitable as the random number generator function within a particular simulation.

This discussion is included for two reasons. Primarily, to demonstrate, in a very minute manner, the level of consideration and detail which go into the development of simulation models. What may appear as a trivial matter to the average user of a combat simulation model, the generation of a random number receives substantial attention in order to ensure validity in the model.

The second reason is to emphasize the need for randomness in a combat simulation. The bottom line is that it is impossible to account for every factor influencing a specific event in the real world. For example, the best trained sniper accounts for current wind speed and direction, range to the target, bullet drop at the calculated range, temperature, target motion, etc. The outcome of these calculations is an aimpoint which should result in a hit. A second round fired under what appears to be the exact same conditions will rarely strike the exact same point. Why? Slight variations in the number of grains of powder in the cartridge, indiscernible changes in wind speed/direction or temperature, changes in breathing

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[3] This example was taken from Ripley, Brian D., Stochastic Simulation, New York: John Wiley & Sons, Inc., 1987.

patterns during trigger pull, etc. all impact on the process. It may be one time out of ten or one time out of a hundred thousand that these variations combine to result in a missed shot, but it happens. This outcome can be considered random.

A simulation reproduces this random effect through random number generation. For example, in the Janus simulation, if all conditions are satisfied for a unit to fire at an enemy target, the final outcome is determined by random number generation. If the simulation is designed for a 90% kill rate under the given circumstances, a random number draw between 0 an 10 will be made and compared to the number 9. If the random number is less than 9, a kill occurs. The other 10% are misses. There is no way to predict, however, when the hits and misses will occur, thus the randomness.

The description of the Janus direct fire algorithm included later in this chapter further stresses the fact that a great deal of detail goes into the development of a simulation model. The potential for detail is unlimited, but more detail requires more money to develop and more computer time to run, considerations which must be addressed.

The negative connotation which accompanies simulation is proliferated because the average potential user lacks even basic knowledgeable about the process and assumes that the "scientists" who develop them do not understand how the real world functions. These two facts can preclude simulations from being used in a productive manner by operational military forces.

It is important to remember that because simulation is mathematical in nature does not mean that a given input will always yield the same result. The stochastic, or probabilistic, nature of a Monte Carlo simulation insures some degree of randomness in outcomes. If understood, this is of great value in a combat simulation model, such as Janus, where the same battle replayed will not yield the same results. "Winners" and "losers" may remain the same but target selection, number of rounds fired to achieve a kill, etc. can vary under the same circumstances, as would be true on the battlefield itself.

## D. JANUS

### 1. Description

The Janus simulation was named for the two-faced Roman god of portals who guarded the gates of Rome by looking in two directions at the same time. It is an interactive, two sided, closed, stochastic, ground combat simulation.

Janus is "interactive" in that the command and control functions are entered on workstations by individuals deciding what to do in crucial situations during simulated combat. "Two sided" refers to the two opposing forces, blue and red, directed simultaneously usually by two sets of players. "Closed" means that the disposition of opposing forces is largely unknown to the players in control of the other force. "Stochastic" refers to the way the system determines the results of actions such as direct fire engagements; according to the laws of probability and chance. "Ground combat" means that the principle focus is on ground maneuver and artillery units, although Janus also models weather and its effects, day and night visibility, engineer support, minefield employment and breaching, rotary and fixed wing aircraft, resupply, and a chemical environment. It supports conflict from individual systems and company sized units through brigade/regimental sized units.

The Janus simulation uses digitized terrain developed by the Defense Mapping Agency by displaying it in a familiar military form with contour lines, roads, rivers, vegetation, and urban built-up areas. Each representation is also familiarly color-coded, i.e. rivers are blue, vegetation is green, and so forth. Most importantly, the terrain affects the line of sight algorithms used for acquiring and engaging targets as well as the maneuvering speed of the simulated system.

Janus represents each individual system with an individual icon. This allows the analyst to observe and modify the actions or parameters of an individual combat process and collect the data from the resultant outcomes. It can also utilize individual icons to represent any number of the same system. Thus a fire team, squad or platoon can all be represented by a single icon if desired and the actions of that unit can be modified observed or quantified.

### 2. Strengths

The strength of the Janus simulation is the strength of simulation in general; its ability to model complex probabilistic behavior. The specific ways in which it does this as well as the application of these processes to mission planning will be discussed in detail in Chapter IV.

### 3. Weaknesses

There are drawbacks in using Janus as the model of interest. Janus is a ground combat simulation, which is less than ideal for NSW purposes. Modeling tactical situations in a maritime environment, specifically those which may include water depth, currents, tides, etc. (such as combat swimmer operations) proves difficult. Additionally, Janus was designed for battalion to brigade size operations. Although individuals can be modeled, the detail with which it is accomplished is insufficient for a special operations force where variations in the human element may have a tremendous impact, specifically when it comes to tactical actions. For example, Janus will not allow an individual mounted on another system to fire at a target if one is acquired. Thus, a fire team approaching the beach in a Combat Rubber Raiding Craft (CRRC) would not fire at an acquired target even if it satisfied engagement parameters. While there are ways to account for such situations to some degree, a SOF model should include this type of detail and capability at the individual level in order to better simulate tactical situations. Although modeling the human element is an inherent problem for any computer simulation, Janus' representation needs improvement for widespread NSW use.

### 4. The Janus Database

As with any simulation, an accurate and complete database is crucial to the operation of Janus. Development, management, and maintenance of the database are essential tasks

requiring detailed knowledge of the structure of the database and how the elements which make it up interact to produce particular results during simulation runs.[4]

The Janus database is complex and includes functions and data relationships where the significance is not intuitively obvious. For historic reasons, the database is arranged "horizontally" - that is, feature by feature rather than "vertically" - or system by system. It was originally deemed more important to be able to change one kind of data about several systems quickly rather than deal with systems one at a time. The database includes information on the physical and performance characteristics of systems (soldier, tank, aircraft, etc.), sensors (eyeballs, binoculars, radars, etc.), and weapons. Information includes sensor detection capabilities, system mobility, capacity and survivability, weapons lethality and range, logistics characteristics, tactical parameters such as target priorities, and so forth. In many instances, a single characteristic for a single unit may be different versus every enemy unit. For example, unique Probability of Hit (PH) values are given for a single weapon versus every valid target.

The database is also complex since it models so many parts of the battlefield in great detail. For instance, line of sight is explicitly modeled to include the effects of intervening vegetation. Minefields are represented as composed of single mines, each at a specific location. Each is modeled as an individual rather than having the entire minefield treated as an aggregate. The relationships between system and weapon characteristics may be obscure, leading to inevitable surprises.

As will be discussed in Chapter IV, it is the robustness of the database and the ability to manipulate it easily and quickly that can provide the insightful analyst with a powerful tool during mission planning. As a simple example, suppose a mission had been planned, entered into Janus and run multiple times, yielding generally successful results. It is noted in the post-run analysis, however, that the same unit is consistently responsible for what

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[4] Department of the Army. Data Base Manager's Manual, Ft Leavenworth, KS: Headquarters, TRADOC Analysis Center, 1993.

appears to be a critical kill at a critical time - and the kill is occurring at 300 meters with a CAR-15. The PH value for the firing unit versus the specific target can be altered by any desired factor and the simulation re-run in order to determine the impact of that engagement. PH values are, in effect, a quantifiable measure of weapon accuracy - the better skilled shooter would have a greater PH value. The potential for mission analysis with this single database entry is obvious. The fact that the database contains dozens of entries for individual systems would indicate additional potential. Utilizing this potential will be discussed at length in Chapter IV.

### 5. A Janus Algorithm - Direct Fire

As discussed previously, simulations contain many submodels. The following is a description of the Direct Fire submodel contained within Janus.[5] While it does not describe all of the mathematical processes involved in the programs, the concept is made clear. This description is included to give potential users of a SOF simulation an idea of the processes and the detail that a simulation involves for what appears to be a straight forward event - shooting at the enemy.

Direct fire takes place automatically during a simulation run when opposing units are within range and have targets. These events are handled by a set of programs which perform the following tasks for a unit each time they are invoked:

-Determine if the unit is able to fire at this time

-Select the target and appropriate weapon

-Fire either one round or a burst and record the event

-Subtract the ammunition used from the units supply list

-Determine when the round will impact

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[5] The description of the Direct Fire Algorithm is taken directly from pages 131-133 of Department of the Army. Software Design Manual, Fort Leavenworth, KS: Headquarters TRADOC Analysis Command, May 1993.

-Make a preliminary determination of the number of kills. At impact time, determine if the kills are still valid. Record kills, if any.

-Calculate the earliest next possible firing time for the unit

-Reschedule the unit for its next firing event

**Initial Firing Requirements** - In order to engage, a direct fire unit must:

-Be alive and operable

-Not be in a Hold Fire mode (a command which can be manually entered for specific units so they will not fire at enemy targets.)

-Not be suppressed by enemy fire

-Not be mounted on another unit ( a weakness in the model)

-Have at least one enemy unit on its potential target list.

If the unit meets all of these criteria, processing continues. Otherwise, it is rescheduled for evaluation at a later time.

**Weapon/Target Selection** - Once the unit is evaluated as being able to shoot, the program looks at the entries in the unit's target list. The entries are processed from first to last. An entry must possess the following qualifications for a direct fire event to take place. If the entry does not possess one of the qualifications, the next entry on the target list is evaluated.

-The target must still be in acquisition range and still be alive.

-The target must be within range of the firing unit's weapon. If the target is in full defilade, the firing unit must be within 50 meters of the target.

-One of the firing unit's weapons must be assigned for use against the target at the current range. That weapon must have ammunition.

-The Single Shot Probability of Kill (SSKP) for the weapon against the target is calculated by referring the PH/PK tables assigned. The SSKP will depend on whether the

firing unit is stationary or moving, whether the target is stationary or moving, the target's posture (exposed or defilade), the aspect of the target (head on of flank), and the target's range. The SSKP may be degraded in certain situations. For example if the firing unit is in MOPP status the SSKP is degraded by the predesignated MOPP factor. If the net SSKP is less than 0.05 the target is ignored.

-The target will be ignored if a smoke or dust cloud intersects the Line of sight (LOS) line between the firer and the target when the weapon is a guided missile which cannot track through smoke and dust.

If no targets fit the firing criteria, the next firing evaluation time is determined and processing for the firing unit is terminated. If only one target fits the criteria, it is selected. If more than one target fits the criteria, selection is based either on the firing priority given to the firing unit for specific targets or, in the case of equal priority, their relative probability of selection is calculated by dividing each target's SSKP by the sum of the SSKPs for all targets. A random number draw determines which target is selected.

**Firing** - If a target is available, a single firing event takes place against the target. The firing event may be a single round or a burst, depending on the number of rounds per trigger pull of the weapon.

Aggregated red units are treated somewhat differently. If there are at least three systems in the aggregated unit, they are considered a single weapon with the capability of firing three simultaneous rounds or bursts. This simulates the red tactic of coordinated fire.

A random number draw is compared to the target's SSKP to determine if it is killed. This number is drawn three times for an aggregated firing unit. If the target is killed, the information about the event is written to a data file for post-run analysis. If the target is not killed and it is not a flyer, another single random number is compared to the SSKP plus a suppression coefficient, a, times one minus the SSKP, eg. (SSKP + a(1-SSKP)). If the

random number draw is less the target is suppressed. Again, information on the firing event is written to a data file.

**Round accounting** - Ammunition accounting takes into consideration the number of rounds fired, and if the unit is a red aggregated unit, the number of units which fired simultaneously. The net ammunition usage is subtracted from the unit's supply of that type of ammunition.

**Impact Time** - The time of flight for a particular round is calculated by multiplying the munition's velocity by the range to the target. The result is added to the firing time to determine impact time (as a time of day). Impact time may affect the firer since some firers cannot move until the round impacts (TOW missile).

**Kill Assessment** - A preliminary kill assessment is made at the time the round is fired. The SSKP for that weapon/target combination is compared to a random number draw. If the SSKP is greater than or equal to the random number, one element of the unit is killed. In the case of aggregated red fire, each round is assessed separately. Units mounted on a killed system are also killed. It is possible that at impact time, the target is no longer alive. In this case the round is considered lost and no kill occurs. Any kills are considered valid at impact time and information on the event is written into a data file.

**Determining the Next Firing Time** - This is computed by adding the total time a unit must wait between firings (DT) to the current time. DT is calculated using the following formula:

DT = AT + RT + TOF + LT

Where:

| | | |
|---|---|---|
| AT = | AIM TIME | This term is always present |
| RT = | RELOAD TIME | This term is added only if the number of trigger pulls since the last reload reaches a predetermined number (i.e. its time to change magazines). |
| TOF = | Time of Flight | This term is added only if the weapon used cannot fire on the move. |
| LT = | LAY TIME | This term is added only if the present fire results in a kill. |

As shown, the direct fire algorithm is designed to take into account as many real world factors as possible in order to model the process of engaging a target. It is important to understand this process, for it shows inherent assumptions and limitations of the model, thus allowing simulation results to be viewed in an accurate manner. As depicted in Figure 2, once the mathematical conclusions are reached (kill or no kill), this information must be interpreted based on an understanding of the process, in order for its value to become significant.

## E. SUMMARY

Simulation is a tool for mission planners, not an end in and of itself. Just as the best quality Snap-On tool is no better than a Fisher Price version if used incorrectly, so too is the case for simulation. While the following chapters will identify multiple areas in the mission planning process where simulation can be of great value, it is important to understand that the information gained from its use must be carefully analyzed and not merely taken at face value. Simulation provides a reliable source for mission analysis, including the ability to determine the potential impact of various factors on a given situation, but by no means tells the planner what <u>will</u> happen in any given circumstance.

# III. MISSION PLANNING

## A. INTRODUCTION

The purpose of this chapter is to outline the types of mission planning conducted by Navy SOF and the circumstances under which they may occur. The discussion will begin with the focus on joint doctrine, and conclude with NSW tactical mission planning procedures. With an understanding of modeling and simulation from the previous chapter, it will become apparent that there is a symbiotic relationship between simulation and many aspects of the planning process.

According to Joint Pub 3-05.5, there are three principles of SO mission planning for specific targets. First, specific targets or mission assignments for SOF should contribute substantially to the strategic or campaign plan being executed. Limited resources and the extensive planning required dictate that a commander selectively employ SOF for high priority operations. Further, the sensitivity of many SOF missions may force the NCA to place specific political, legal, time-of-day, geographic, or force size constraints upon the employing force.

Second, SOF missions are complete packages - insertion, resupply, fire and maneuver support, extraction - to be thoroughly planned before committing the force. The nature of the target, enemy and friendly situation, and environmental characteristics of the operational area are key planning factors. They will dictate the size and capability of the assigned force, the nature of tactical operations, methods of insertion and extraction, length of force exposure, logistic requirements, and size and composition of the command and support structure.

SO targeting and mission planning must be conducted in coordination with all applicable theater and/or task force agencies. Conventional targeting and strike response time for ordnance delivery is extremely quick and may affect SOF infiltration routes, hide sites, or target areas. Conventional force planners must be involved during the early

planning stages to facilitate coordination and deconfliction of all assets and to allocate conventional resources to support and augment SOF activities. Detailed targeting and mission planning is vital to successful mission execution and to the survival of deployed operational elements.

Finally, SO rarely can be repeated if they at first fail, since SO targets normally are perishable either from a military or political viewpoint. Therefore, thorough, detailed, and whenever possible, repeated rehearsal is critical. These rehearsals should be conducted with the exact force to be committed and under the same time and distance constraints in an environment whose terrain and weather condition closely approximate the operational area. A by-product of such rehearsal is that the operational element absorbs alternative courses of action and is better able to adapt to changed circumstances during the mission. Commanders should recognize and plan for such preparation time.

## B. MISSION PLANNING

These principles of mission planning apply across the spectrum of conflict, although their emphasis may change depending on the type of planning being conducted and the external constraints affecting the process. Following is a discussion of the three types of planning commonly conducted by Navy SOF. Joint doctrine describes deliberate and time-sensitive planning. The third type, referred to hence forth as dynamic planning, is a combination of the two types.

### 1. Deliberate Mission Planning

Deliberate planning refers to planning for a hypothetical situation involving the deployment and employment of apportioned forces and resources projected to be available. It relies on assumptions regarding the political and military situation that will exist when the plan is implemented. Deliberate planning is applicable across the operational continuum.

Deliberate targeting and mission planning are normally conducted in peacetime. National security policy is formulated by the NCA and conveyed through Chairman of the Joint Chiefs of Staff (CJCS) guidance to the combatant commanders, who build operational plans. Objectives and guidance originate at the national level as broad concepts and are refined by subsequent commanders into concepts applicable to the area of operational responsibility (AOR). Target development flows from objectives and guidance reflected in operational plans and statements of commander's intent.

Deliberate targeting and mission planning can also be applicable in a protracted crisis situation, such as the lengthy process leading up to Operation Just Cause in Panama, or in a wartime situation as part of a theater campaign plan, exemplified by Operation Overlord against Normandy. Regardless of the situation, deliberate planning involves a lengthy period of time.

Once the targeting process is complete and forces have been selected, the mission planning process begins. The target is first validated as appropriate for execution by SOF. Once a target is determined feasible, joint intelligence assets are tasked to create a Target Intelligence Package (TIP). Since SO require very detailed operational and intelligence data, Plan of Execution (POE) planning can not commence in any detail until the TIP is complete.

The POE is a highly detailed plan written by an operational element. It contains the best available operational and intelligence information on the target and surrounding area. Exhaustive rehearsals and demonstrations of the POE are conducted in the field and shortfall assessments are continually made. Once the POE is completed, the entire planning packaged is compiled into a Special Operations Mission Planning Folder (SOMPF) and submitted for approval. This final product is maintained and periodically updated as long as the target remains valid for SOF employment.

Execution planning is implemented only when such a plan is to be executed. It involves updating of operational and intelligence Essential Elements of Information (EEI's). The Mission Planning Agent (MPA), a combination of both staff and operational forces,

including the forces designated to execute the mission, commence isolation. In many cases this may be a Naval Special Warfare Task Group or Task Unit (NSWTG/TU). Isolation activities include last minute mission planning, coordination briefings with insertion/extraction assets, individual training, rehearsals, adjustments in mission plan, equipment preparation, and rest or sleep immediately preceding insertion into the target area. Intelligence and operational updates continue until the target is prosecuted. Execution mission planning assumes the characteristics of time-sensitive planning as execution nears.

### 2. Time-sensitive Mission Planning

Time-sensitive planning refers to planning for the deployment and employment of allocated forces and resources that occurs in response to an actual situation. Like deliberate planning it is applicable across the operational continuum. Time sensitive SO targeting and mission planning demand flexibility. The ability to meet changing situations with the time, intelligence, and manpower available is critical. While contingency targeting and mission planning may be either deliberate or time sensitive in nature, crisis and combat mission planning are normally time-sensitive. Operations such as Urgent Fury in Grenada have emphasized time-sensitive planning.

Time sensitivity can be viewed from a targeting or mission planning perspective, or a combination of both as in the case of a personnel recovery mission. A target is deemed time-sensitive when it requires an immediate response because it poses (or will soon pose) a danger to friendly forces or is a highly lucrative, fleeting target of opportunity. Time-sensitive targets are usually mobile, such as a mobile ICBM, or lose their value quickly such as a bridge being used for an enemy advance.

A mission is time-sensitive when there is an operationally small time window during which the objective of the mission must be obtained. In this case the objective of the SOF mission may be available for reconnaissance or attack over a long period, but the value is high only at a specific time. For example, a radar site just prior to an airborne assault.

The time-sensitive planning cycle begins with a Mission Tasking (MITASK) which should be sent no less than 96 hours prior to the earliest anticipated launch time (EALT) - the time at which a special operations tactical element and its supporting platform depart the staging area for the operational area. This MITASK generally specifies force selection in order for the actual tactical element to be involved in the planning process at the earliest possible opportunity.

No later than 72 hours prior to the EALT, the MPA submits a mission concept (MICON) to the Special Operations Component Commander (SOCC) detailing the proposed method of completing the assigned mission. The SOCC may approve, alter, or disapprove the concept and will respond to the MPA within 8 hours. With MICON approval, detailed mission planning begins. Mission rehearsals and demonstrations are conducted only as time permits.

### 3. Dynamic Mission Planning

Dynamic mission planning at the tactical level is not formalized in doctrine, but closely resembles a combination of both deliberate and time-sensitive planning. Dynamic planning is applicable across the operational continuum and is best suited for medium to extended duration operations where lag time in the employment of tactical elements may occur. In this situation, tactical elements and their supporting planners analyze the commander's intent for the AO. With a clear understanding of this intent, and a clear tactical picture of the battlefield, MICONs can be generated without having received a MITASK. These MICONs are submitted up the chain of command for approval.

Dynamic planning resembles deliberate planning in several respects. First, there is no formal time constraint placed on the planners, other than the duration of the conflict. Second, the planners are working from a statement of the commander's intent and generating targets and missions designed to employ Navy SOF forces in a manner which best

contributes to that intent. Finally, multiple proposals may be submitted, revised, and resubmitted before a single mission is excepted for execution planning.

Once a mission is accepted for execution planning, the dynamic planning process immediately becomes time-sensitive in nature. The time criticality will depend on the mission's place in the scope of the campaign at hand. The tactical element must be prepared, however, to enter the time-sensitive planning process at the point of MICON approval with as little as 48 hours remaining until EALT.

Dynamic planning is exemplified by Navy SOF experiences during Desert Shield/Desert Storm. Several MICONs were developed by task unit/task group/platoon personnel and submitted for approval. Each mission was designed to significantly contribute to the commanders intent.[6]

### 4. Naval Special Warfare Tactical Mission Planning

Mission planning doctrine contained within the 3-05 Joint Publication series focuses on SO planning from the perspective of the commander of a theater Special Operations Command (COMSOC). They provide procedures for the COMSOC's participation in theater-level planning and the supervision of tactical planning by subordinate SOF elements. The joint publications do not address detailed tactical mission planning (route planning, actions at the objective, etc.) because this activity is governed by service guidance and unit standard operating procedures (SOPs). They do, however, identify the circumstances under which tactical mission planning may occur.

Each type of mission planning discussed to this point differs in the role that the tactical element plays, yet there is a commonality among all three. Deliberate planning for a mission such as Sontay is the ideal situation for SOF: a focused objective with ample time

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[6] From a discussion with LT Michael Riley, a SEAL Team ONE platoon commander in theater during the conflict who was a primary participant in the dynamic planning process.

and resources to plan and rehearse courses of action (COAs) prior to execution. While the luxury of time and resources may not exist for a mission to be executed within 96 hours, tactical planning, i.e. determining COAs, selecting routes, weapons, and precise force size and structure for the operation, remain virtually identical across the board, with time constraints as the primary influence on the process. This type of planning is what the joint publications refer to as being governed by service and unit guidance, and is the type which will be focused on throughout the remainder of this thesis.

The primary source for NSW mission planning doctrine is the recently published Naval Special Warfare Mission Planning Guide. This publication is the culmination of a community wide effort to provide a single source document for standardized mission planning guidance to the operational elements of Naval Special Warfare. The scope of the publication is to enable mission planners to take a mission directive and, through standardized sequential and variable events, produce tactically evaluated mission briefs, including course of action (COA), concept of operations (CONOPS), briefbacks, warning orders, and patrol leader's orders. The briefs which are produced can be viewed as a by-product of the plan that is developed in the process. Furthermore, the guide provides the tools necessary to generate MICONs without the aid of a mission directive.

The Naval Special Warfare planning cycle can be viewed as a process commencing with an alert, continuing through a series of sequential and variable events, and concluding with the patrol leader's order.[7] Many of the events discussed in the NSW Mission Planning Guide are directly related to the development of COAs, and will be discussed in the following chapter in the context of utilizing simulation to assist in the event during the planning process. Simulation does not necessarily play a role in each of these events, but may contribute significantly to many of them.

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[7] For a complete listing of sequential and variable events see the Naval Special Warfare Mission Planning Guide, p. 1-6.

## C. PLANNING WITH SIMULATION

The following chapter is the bridge between the concept of modeling/simulation discussed in Chapter II and the mission planning process described above. It will begin somewhat broad in scope, with an examination of the role of simulation during deliberate, time-sensitive, and dynamic mission planning, addressing unique applications in each circumstance. The focus of the chapter, however, will be on the application of simulation during the tactical or execution planning phase, where regardless of the circumstances leading to this point, the actions of tactical planners can be viewed under a single lens.

The sequential and variable events discussed in the NSW Mission Planning Guide will be used as a framework for discussing implementation of simulation in mission planning. These events serve primarily as a source to focus the planner on an efficient path which should cover all aspects of the planning. Simulation may not play a significant role during every minute of the planning process, but used correctly it can enhance the final product.

## D. SUMMARY

Regardless of the circumstances surrounding mission planning, the process at the tactical level is similar enough to warrant categorizing it as a single entity. Combat simulation modeling has the potential of not only aiding in the process of mission planning, but filling in certain gaps that are difficult to account for when time and resources are lacking. While the NSW planning process in already efficient and effective, simulation can enhance it by forcing planners to evaluate the relative importance of various aspects of a mission, as well as by reducing the time spent in many areas of the planning process. Understanding the role of simulation and proper methods of application will offer planners an additional tool for maximizing effectiveness and employment opportunity.

# IV. SIMULATION IN THE NSW MISSION PLANNING PROCESS

## A. INTRODUCTION

Simulation is a powerful tool if and only if it is used correctly. There are many circumstances where its use may be extremely beneficial, but there are also circumstances where it is not applicable. This chapter has two purposes. First, to discuss the unique circumstances afforded during deliberate, time sensitive, and dynamic planning where simulation could be employed. Second, to provide a detailed description of the role of simulation in a critical aspect of mission planning - course of action (COA) development, analysis, and selection. Providing a list with detailed explanation of all possible uses of simulation is beyond the scope of this thesis. Other aspects of mission planning where simulation may be applicable will, however, be identified and briefly addressed. The description of simulation in COA planning can be extrapolated to these other aspects with relative ease.

## B. ASSUMPTIONS

There are basic requirements which must be satisfied before simulation can be employed by a MPA or at any NSW command.. These requirements are assumed to exist for the purposes of this chapter and are discussed below.

### 1. Analyst/Systems Expert

The most important consideration, aside from possessing the hardware to run the simulation, is to have a skilled analyst available who is familiar with the capabilities and operation of the simulation. While there will undoubtedly be numerous users, at least one person with an understanding of the mathematical processes involved and a familiarity with the algorithms and the manner in which certain processes are modeled should be available in order to maximize the effectiveness of the simulation.

For example, in Janus air defense detection is modeled as a cylinder with unlimited altitude capabilities. A simulation which models air defense as a hemisphere will have different implications in the analysis process.

Additionally, since simulations are run on computers, a person with system level knowledge will prove invaluable. System glitches may unnecessarily prevent use of the simulation when someone with system knowledge may be able to easily remedy the situation.

#### 2. Database

The simulation database must be as complete as possible and include system, sensor and weapon characteristics for all relevant friendly and enemy forces. While it is possible to enter new information during the planning process, time constraints may preclude this option. Furthermore, the accuracy of the information in the database must be a consideration during analysis of simulation results.

#### 3. Terrain Files

The DMA digitized terrain files which Janus uses are the same as those for other SOCOM considered models, including JTS and JCM. Assuming time may be a critical factor, the correct terrain file for the AO must be available and, preferably, already loaded into the system. The analysis potential using 'similar terrain' rather than the actual terrain still exists but greatly diminishes the analysis results.

#### 4. Intelligence

The more information that is available on the enemy forces and equipment that may be present in the AO, the more valuable a simulation will be. There is little need for using a simulation to plan routes when enemy detection probabilities are not a consideration, other than to evaluate the effects of route timing on synchronization.

### 5. Mission Type

Of the primary SEAL mission areas listed in the NWP 15 series, simulation applies mostly to Direct Action, Special Reconnaissance and Counter Terrorism. Although the problem of modeling the impact of Foreign Internal Development missions on an overall campaign is being considered, the solution is not yet at hand.

## C. DELIBERATE PLANNING

Deliberate planning offers the luxury of time generally not found in military planning. For this reason there are unique opportunities for the application of simulation. Once an operational commander receives objectives and guidance, the deliberate planning process begins. Guidance may be very broad in scope, but will identify an AOR. Stated objectives will be used extensively for target selection and subsequent planning. Simulation offers a powerful tool during this process.

As deliberate planning relies on assumptions regarding the political and military situation that will exist when the plan is implemented, simulation can be used to create enemy tactical scenarios to include best case, worst case, and most likely case. Once the targeting process is complete, a plan is developed against the prospective target which can be run on the simulation. A post-run analysis of detections, engagements, timing, losses to both sides, etc. may indicate critical aspects of the plan where refinement should be considered. Countless iterations of this process are possible.

Once a plan is developed that appears satisfactorily successful from an operational standpoint as well as from an analysis of simulation results, that plan can be tested against a different potential enemy situation. The result of continuing in this manner is the development of a plan which is most suitable to a wide range of tactical possibilities. If a single plan such as this is not acceptable, a detailed plan for each potential situation can be developed.

Additionally, the luxury of time during deliberate mission planning offers the opportunity of conducting any number of sensitivity analyses of a particular plan ( 'what ifs'). Noting the effect of changing the number of personnel conducting the mission, the weapons they carry, the absence/presence of supporting assets, the position/strength of enemy forces, and so forth may identify go/no go criteria or critical aspects of a mission where detailed contingency planning needs to be done.

Take, for example, the planning for Sontay. Four hundred yards south of the prison camp lay a walled compound similar in size and appearance to the POW camp. U.S. analysts concluded that it was a school house, although there was some conjecture about the presence of troops. A simulation of the Sontay plan run both with and without a reaction force located at the "school" may have yielded important information pertinent to the execution of the plan. As a sidenote, it is better to be lucky than good (and best to be lucky and good). During the execution of the mission, the confusion created by the fire of the lead HH-53s miniguns and illumination flares dropped by the C-130s caused one element to mistakenly land at the "school", which in fact was a barracks full of armed troops. Had this group not fortuitously neutralized the enemy force located there, they would have posed a deadly threat as the raiders withdrew from Sontay.[8]

Many of the factors discussed above can also be analyzed by multiple rehearsals, but one must weigh cost considerations. Running a plan such as Sontay on a simulation may result in identifying necessary modifications. The need for these modifications may also have been realized during rehearsals but at the increased cost of time, manpower, assets, fuel, and risk of losing operational security. This is not to say that simulation can replace rehearsals. Nothing is farther from the truth. Simulation may, however, enhance rehearsals by preempting some of the initial stages, or by identifying potential contingencies to be rehearsed.

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[8] Vandenbroucke, Lucien S. Perilous Options: Special Operations as an Instrument of U.S. Foreign Policy, Oxford: Oxford University Press, 1993, pp. 68-70.

## D. TIME-SENSITIVE PLANNING

When the luxury of time is absent, planners rely on traditional proven methods resulting from both doctrine and experience. In both arenas, rehearsals are considered one of the most valuable tools for mission planning and preparation. With as little as 96 hours to plan and prepare for a mission, rehearsal time becomes extremely limited. If simulation is used during the planning process as an analysis tool, then when it comes to rehearsal time, especially if limited, the simulation can provide visual moving representation of the plan being executed. An operational force can view a simulation run of the plan, which can be paused for discussion at any particular point. Furthermore, a last minute contingency which may be identified during this process, such as the "school" at Sontay, could be entered into the simulation and run in a matter of minutes. While this may not allow for detailed planning to commence afterward, it does provide awareness, which may make the difference.

## E. DYNAMIC PLANNING

Without a discussion of the reasons why dynamic planning may be appropriate, it falls between deliberate and time-sensitive as far as being constrained by time. The primary difference between the three is that in dynamic planning a conflict is already in progress. As a result, a tactical picture of the battlefield can be maintained, whereas in both other circumstances, the battlefield may not yet have formed.

With a picture of the battlefield and an understanding of the commander's intent for the AO, simulation can be used for targeting as well as mission planning. If, for example, 10 MICONs were developed from the target analysis process, each could be run on a simulation in order to determine their impact on subsequent missions, a region, or on a campaign as a whole. This may give some insight as to a priority of MICONs for more extensive planning.

Once a MICON is approved, the planning process becomes time-sensitive, and the role of simulation changes.

## F. COA PLANNING

In this section of the thesis, the role of simulation in COA planning will be discussed with reference to a notional scenario created specifically for this purpose. Appendix A includes a brief description of the situation and mission tasking and Appendices B and C depict friendly and enemy order of battle, respectively. This scenario was developed for illustrative purposes with precise tactical realism a secondary concern. Thus, some defensive positions or choices for offensive tactics may be flawed. The scenario does, however, provide an understandable simulated environment for demonstrating and evaluating the value of simulation. Visual representation of examples will be used whenever possible.

### 1. Development

The NSW Mission Planning Guide states that as a rule of thumb, three viable options for each of the five phases of a mission (insertion through extraction) should be developed. These options are then consolidated into three complete COAs. The options for each phase are based primarily on available assets, including both equipment and personnel, terrain in the AO, mission requirements, level of training, and past personal experiences.

The role of simulation in the initial development of COA options is limited as the brainstorming process precedes analysis. Simulations do not monitor asset, equipment, or personnel availability, nor do they take into consideration the stated or implied tasks present for a specific mission or the past experiences of those planning the mission. At this early stage of the planning process, intuition, experience, and institutional knowledge reign. Yet simulation can be used to assist even the best planner in developing COAs.

Once order of battle (OB) information is developed into a simulation scenario, the situation map that results is a valuable tool in the brainstorming process for COA options. A detailed map study of the AO and the specific target area is made possible by the digitized terrain. Guesswork on line of sight capabilities is largely eliminated. The terrain between

contour intervals does not have to be estimated based on the overall terrain, rather it can be determined precisely by the line of sight (LOS) function.

Additionally, using the LOS function, the range of enemy sensors and weapons can be visually depicted for initial platform selection and route planning. For example, in the presented scenario, a visual display of the LOS capabilities of the target SA-4, shown in Appendix D, made air insertion within that arc unrealistic except at extremely low altitude. The lack of a strong coastal radar, however, indicated insertion by a maritime asset as more feasible.

The simulation database can also be used to verify system characteristics for both friendly and enemy equipment. COA options that are dependant on the range of an enemy weapon system or the fuel capacity of a particular platform can be quickly checked before they are further developed.

In the COA development process, experience and external factors such as asset and equipment availability are determinant. The strength of simulation lies primarily in its use as a situation map and a database. When time constraints enter into the planning process, these uses may be of great value to a planner.

**2. Analysis**

Once three viable COAs are developed, planners must analyze them in order to determine strengths and weaknesses and ultimately make a recommendation to the commander. While this generally may not include detailed planning of routes and actions at the objective area, use of a simulation makes this not only possible but beneficial to the planning process as a whole. Planning routes at this stage can be done with a relatively small time expenditure, depending on the detail of the route, but will serve to provide a commander with both more information about the COAs and more confidence in the recommendation of the planners when the time comes for a decision.

For the purposes of illustration, three COAs were developed for our notional scenario. All three COAs involved insertion by two Combat Rubber Raiding Craft (CRRCs) and infiltration by foot to the objective area. COA 1 involved moving two four man elements into the target area for a standard direct action assault using a base element and a maneuver element and demolition for the target. COA 2 consisted of moving to within standoff weapons range for an AT-4 and a TOW II. COA 3 used an 60mm mortar from 1000 meters.

### *a. Routes*

Once these COAs were developed, the appropriate NSW forces, weapons, and sensors were selected from the data base and deployed in the scenario. Following a general map study, the LOS function was applied to the point/patrol leader (PT/PL) member of the patrol and used to determine routes into the target area which would provide both efficiency of effort and protection from detection.[9] The routes were timed in order to coordinate arrival at the final assault positions in COA 1, and in all cases timed to ensure mission completion prior to the launching of the fast movers in the invasion force.

Appendix E shows an example of a route for COA 1. Timing is accomplished by using stop nodes or timed stop nodes in the route.. Since Janus is interactive there is the opportunity to have a halted unit continue progress or halt a progressing unit during a scenario run.

While Janus does not assign a quantitative estimate of the probability of detection over the route as a whole, a graphic verification of the scenario will indicate

[9] Once the LOS function is selected, a system must be chosen to apply the function. The LOS capabilities of this system at its present location will be displayed. From this point, however, the LOS capabilities of the same system can be displayed at any given point within the terrain file merely by placing the cursor at that point and clicking the mouse button. This allows proper tactical deployment of systems as well as detailed route planning.

parameters for appropriate combinations of friendly and enemy forces. For example, there is a selection matrix for graphical verification of the scenario developed as COA 1. Selecting the sensor characteristics of the automatic weaponsman (AW) versus the opposition rifleman on the target site produces the information shown in Appendix F. This performance curve can be used to determine at what range detection is both possible and probable. They can be generated for weapons capabilities, engagement parameters, and PH/PK information as well, all with a single click of a mouse button.

After route selection, successive scenario runs will provide information about the validity of the route. During a scenario run, enemy sensor detection capability shows up on the screen as indicated in Appendix G, as well as being recorded in the post run data file. It is important to realize that these detections indicate only that that particular point on the route fell within the detection capabilities of the enemy unit. This information must then be put into context of the mission by the planners. Ambient lighting conditions, camouflage, concealment which may not have been present on the terrain file, surprise, and so forth may all impede that detection and make the route more valid. Janus has alternate databases for day and night conditions, and JTS also models different physical positions, such as crouching, but it is imperative that these facts are known during COA analysis.

Changes in enemy positions can be made in minutes. Stationary forces such as those in the target area on COA 1 can be given patrol routes. The impact of these possibilities on detection probabilities and on timing considerations can then be evaluated with additional scenario runs.

***b. Actions at the Objective Area***

Actions at the objective area are the primary focus of mission planning. As stated earlier, special operations can rarely be repeated, and mission success can not be achieved without successful actions at the objective area. Determining the type of action (in our scenario DA or standoff weapon assault), the correct force structure, weapon types, and

so forth are critical decisions. Simulation can aid in these decisions both heuristicly and analytically.

Using simulation may assist in determining both weapon selection and most effective position for the final assault. In the notional scenario, three COAs were developed for actions at the objective area. For illustration purposes, five runs were conducted for each COA scenario. A look at the five post-run data files for each COA showed that the TOW II at 500 meters consistently scored a lethal hit in less shots than did the AT-4 at 100 meters. While this may not be surprising, there is now data to verify the fact. This information may impact on both the number of weapons necessary for the assault force as well as force size considerations.

A look at the database values could also have provided the information about the TOW II versus the AT-4. What simulation offers, however, is the ability to note the effect that varying the weapon selected and the firing range has in regard to detection probability, attrition rates, and kill rates for the target.

Simulation can also assist in determining the best range at which to fire the weapons. Beginning at the weapons maximum effective range, the firing range can be decreased by appropriate increments and the respective effect on the probability of kill recorded. This information can then be compared to both enemy detection and enemy PH/PK information, the goal being to locate a point of compromise where weapons accuracy is satisfactory while detection and engagement by the enemy are not a foregone conclusion. This can also be translated into the best position for observation of an airfield or a harbor where view is maximized while detection minimized.

Once again, a simulation only considers details which it has been programmed to consider. Vegetation which does not appear in the terrain file or a recently erected building may render a firing or observation position useless once the operational element arrives on the target. When this is not the case, however, simulation may save hours of reconnaissance time by assisting in the location of a position before deployment.

The use of simulation during the mission planning process will also add factual analysis for responses to questions often asked by commanders during the course of a briefing. For example, "How would you rate the chances for success on this mission?" Again, Janus or JTS will not provide a numerical estimate for the overall chances of success of a particular scenario. Multiple scenario runs, however, will provide the information necessary to help make this type of assessment. A route which is masked on 49 out of 50 runs, or actions at the objective which result in success with no friendly casualties on 90 out of 100 runs provide a quantitative measure of the probability of success. More important than the actual number is the fact that the analytic power of simulation has validated rather than refuted the plan, which should increase the confidence of the operators as well as the commander making the final employment decisions.

The reasons for Go/No Go criteria are often requested by commanders during briefings as well. There are tactical reasons for a criteria such as having 6 SEALs available for the final assault which require no computer analysis. For example, command and control considerations, security at the objective area, search teams, etc. These considerations may not, however, justify a No Go criteria of 10 SEALs. If 100 simulation runs of a particular scenario show attrition increasing and overall mission success declining with an assault force of less than 10, and this number is desired by the officer in charge (OIC), then the criteria gains a certain level of justification. Furthermore, 100 runs of the mission will give a percentage of how often 6 or 10 SEALs actually were available at the target area for the final assault.

#### *c. Multiple Runs*

A single scenario run can provide certain insights, but meaningful analysis requires multiple runs. The probabilistic nature of a simulation necessitates multiple runs in order to determine recurring trends or events which are anomolies. The idea that battle is probabilistic and an event will never repeat itself exactly indicate the need for repeated

testing of a plan. In training and preparing for a mission, multiple rehearsals are conducted both to familiarize the operators with the plan as well as to identify and remedy problem areas. A single rehearsal will not identify every problem. What goes right the first time may not go right for the next ten rehearsals. The same is true of a probabilistic simulation, thus the need for multiple runs.

### 3. Selection

Many factors will contribute to the decision of which COA to recommend as the primary choice, such as asset availability, training, and instincts. These factors have been and should continue to be the primary source of selection criteria. Furthermore, a well planned mission will likely result in success when run on a simulation. Selecting a COA which has consistently resulted in detection, personnel losses, or mission failure when run on a simulation, however, may not be the right choice. Locating the points at which detection occurred or where engagements resulted in losses will allow planners to evaluate whether or not they believe these are risks to the mission and whether or not they are acceptable. At a minimum, problems which are identified by a simulation encourage another look, forcing planners to be honest about the COA chosen and counterweighting the common tendency to select the desired option in the face of indications to the contrary. The end result should be an improved plan.

In today's world where there is a very small margin for error, additional reassurance to a commander may make the difference between deploying to the target area or back to the team area. Since simulation can benefit operators and planners during the mission planning process, it will require little additional time to conduct a statistical analysis of a particular mission. Multiple runs and the statistical analysis which follow can be achieved by an analyst who is not directly involved with mission planning and preparation. In the end, providing the tactical considerations used to determine the primary COA option and backing that information up with statistical analysis from a simulation should increase the confidence

of both operators and the commanders who will make employment decisions, resulting in increased opportunities and success.

## G. TIME CONSIDERATIONS

The previous discussions have centered around being able to make multiple scenario runs. It is important to understand that scenario development and scenario runs both take time. Assuming that the intelligence was available on both friendly and enemy OB, scenario development for something of the scope presented in the notional scenario could be accomplished within approximately 4-6 hours. This would include loading the correct terrain file, extracting the appropriate systems from the database, and using the LOS and VIEW functions to tactically deploy systems in sound positions in the vicinity of intelligence reported locations. At this point, existing offensive plans (such as those of the invasion force) are built within the scenario.

Creating a route for a given system, such as an aircraft, can be accomplished in less than a minute if precise turning points are not necessary. In the case of the routes for the SEAL elements, where a more precise terrain study is necessary in order to maximize efficiency and limit detection probability, 10 to 15 minutes may be required. Planning indirect fire missions, such as artillery bombardments, can also be achieved in a matter of minutes, assuming targets and timing are known.

Scenario runs can be conducted in real time if desired, but more commonly at a rate of up to 20 times normal speed on Janus and JTS, making multiple runs a viable option. Increasing run time does not limit the detail or accuracy of the scenario, rather it is a function of CPU capabilities and workload.

The time required for post-run data analysis will depend on the detail of analysis desired. Post-run data files contain a great deal of information, and it is necessary to focus the analysis if time is constrained.

As is the case with all computer software, there are intricacies within simulations which, once mastered, significantly reduce the time required to develop and run a scenario. Route copying functions and graphical scenario verification are examples. Repeated use will undoubtedly result in the most efficient and effective use of a simulation such as Janus or JTS.

### H. CONCLUSIONS

SOF operators are renowned for their attention to detail during the planning process and their ability to adapt and overcome when obstacles hinder a mission. Preplanning for such obstacles can only benefit those conducting the mission. Whether it is used for locating potential detection threats, determining force size or weapon selection, or merely as a rehearsal tool, simulation can improve on an already fined tuned planning process.

There are many more potential uses for simulation than those which have been described. Some of these will be discussed in the following chapter, but repeated exposure and use by the operators themselves will undoubtedly result in many unique applications for the NSW community. This chapter has demonstrated the potential use of simulation during tactical mission planning. The ideas and processes described can be extrapolated as appropriate as additional uses for simulation are undertaken.

# V. CONCLUSIONS AND RECOMMENDATIONS

In a time of doing more with less, it is important to understand that there are more potential uses for simulation than assisting with route development and weapon selection. Having demonstrated its role during the mission planning cycle, the following is a cursory discussion of additional roles for simulation in the NSW community as well as a description of models other than Janus that SOCOM is currently evaluating and developing.

## A. ADDITIONAL ROLES FOR SIMULATION IN NSW

### 1. Situation Map

One of the first actions to take place when mission planning commences is the creation of a tactical situation map. This "sitmap" normally includes the disposition of all known friendly and enemy forces in the AO as well as the detection capabilities of radars located both on land and on naval vessels. Throughout the planning process it will be referred to for COA development, route planning, and so forth. Maintaining the sitmap in an accurate, readable, and usable state is generally the job of the intelligence directorate (N2) and requires a great deal of time.

A high resolution simulation such as Janus can be used in place of the conventional situation map. Once the terrain file is loaded, all available information on friendly and enemy forces can be pulled from the database and placed into a scenario file. Forces and equipment will be identified by appropriate icons which can be changed to suit the user as desired. Using a simulation for this purpose is simple and the advantages are substantial.

First, the simulation terrain graphics provide an accurate and easily updatable pictorial depiction of the battlefield. Second, it interacts with the database to provide, on request, visual representation of sensor and weapon capabilities to include minimum and maximum ranges and the orientation of platforms such as anti-aircraft artillary (AAA) (if they are known). Third, any number of overlays can be created to show routes of reaction

forces, CAS flights and so on. Finally, creating the sitmap on a simulation amounts to the initial development of the scenario which will eventually be used for COA analysis and detailed mission planning.

### 2. Database

The database on a high resolution simulation such as Janus contains dozens of data entries for every piece of equipment. Rather than referring to manuals on enemy equipment to find characteristics relevant to mission planning, a simulation database can be used to store the information in a categorized easily accessible manner. Furthermore, weapon and sensor range capabilities can be visually depicted with the click of a mouse button rather than swinging arcs on a topographical map. The impact of terrain features is precisely calculated not guessed. The process of developing such a database may be time consuming, but the result would be a valuable mission planning tool.

### 3. Briefing/Debriefing Tool

Utilizing simulation during the planning process will also provide a tool for briefing purposes. A commander receiving a COA, CONOPS, or other related briefing will see not only a professional interactive presentation, using command and control (CAC) overlays for relevant aspects of a mission, but will also be privy to analysis capabilities during the brief.

Following mission execution, a simulation can be used to compare actions during the mission to those preplanned. Changes to the original plan which occurred during the mission can be entered into the simulation and their impact assessed. This serves not only as a potential source of lessons learned, but also as a way to verify the accuracy of the model, comparing actual mission results to those predicted by the simulation. Additional COAs which may result from a post-mission analysis can be run and their effectiveness assessed.

Using open source information, USSOCOM J-5C developed scenarios of the Task Force Ranger mission in Mogadishu and the SEAL mission at Patilla. Certain parameters

within the model were adjusted in order to create historically correct scenarios. Such a scenario allows commanders to visually replay events, any number of times, and conduct analysis as desired, offering a tremendous potential for lessons learned.

### 4. Training Scenarios

Developing a scenario for a training mission that is both realistic and provides an environment conducive to achieving the training objective is a difficult task. Just as in the case of a situation map, a simulation can be used to develop a training scenario. Opposing forces and equipment can be situated based on historical scenarios, OPLAN/CONPLAN scenarios, or merely in such a manner as to be tactically sound.

Simulation will provide the intelligence and operations directorates (N2 and N3) with the capability to develop scenarios which focus on a certain aspect of training, such as the use of standoff weapons. By creating different "threat packages" and altering locations and strengths of enemy forces, a scenario can be developed and tested to make a direct assault on a target less than desirable.

### 5. Gaming

Utilizing simulation for training purposes offers a unique opportunity for development of tactical prowess in the tactical leaders of operational forces. Besides offering an analysis tool for mission planning, a multi-sided simulation provides an effective arena for gaming missions with opposition forces without the time and cost of actual force on force training. In "Winning the Next War: Innovation and the Modern Military" Stephen Peter Rosen discusses the role of simulation and gaming in determining new military doctrine in the case of naval carrier aviation.

The potential of naval aviation was clearly demonstrated in WWI. The question which became painfully apparent was whether aircraft carriers were to remain the eyes of the battleships or constitute an independent strike force that would replace the battleship as the

dominant naval weapon. There were no realistic fleet exercises that could be used to test the validity of the proposed new role for aircraft carriers. One attempt in 1923 used battleships as nominal aircraft carriers and single aircraft had to represent squadrons, because real carriers and airplanes were not available. The value of the resulting information was limited.

Simulations of naval warfare, however, could be used to extrapolate technological trends in the strategic environment. No navy in the world could put two hundred aircraft out to sea on aircraft carriers in the 1920's. But what if they could? This sort of what if can be, and in fact was analyzed with simulation and gaming. The doctrinal changes involving carrier aviation are apparent in today's navy and the evidence points to simulated engagements performed in war games as the reason.[10]

The process that Rosen discusses can be extrapolated to SOF fairly easily. There are often an over abundance of constraints placed on an opposition force during a training mission, both for safety reasons and to ensure the opposed unit achieves their training objective. After all, time and resources are limited.

Simulation can help remove these constraints. Facing an experienced operator in an opposition role without safety considerations offers a safe environment to develop and test innovative ideas. A junior officer or non-commissioned officer who is challenged by a commander with a "Kobi Oshi Moru"[11] must demonstrate their knowledge of tactics, capabilities of men and equipment, and their personal ability to perform under pressure. All of this can be evaluated by a commander without deploying. Again, simulation should never be considered as a substitute for actual training, rather it is an effective supplement.

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[10] Paraphrased from Rosen, Stephen P. Winning the Next War: Innovation and the Modern Military Ithaca: Cornell University Press, 1991, pp. 68-71.

[11] Kobi Oshi Moru is the name given to the unwinable scenario that Cadets faced before graduation from Star Fleet Academy on the original Star Trek. Interestingly, this simulated scenario forced Captain James T. Kirk to innovate in order to survive, and thus become the only cadet to ever succeed in a Kobi Oshi Moru.

## B. EMPLOYMENT CONSIDERATIONS

The following subjects are addressed only briefly with the intent of providing the NSW community a clear concept of what may be involved with acquiring and implementing a combat simulation model.

### 1. Hardware/Software

Janus is currently run on an UNIX based HP workstation. JTS and JCM will soon be UNIX based as well. It is inevitable that technological advancements will allow simulations such as Janus, JTS, or JCM to be run on a desktop or laptop PC, but that is currently not the case. The software for any of the aforementioned simulations is already owned by the military and can be acquired free of charge.

### 2. Database

#### *a. Creation*

The initial creation of an accurate database is a major task. There are already databases maintained by commands such as the Army's Training and Doctrine Command Analysis Command (TRAC) that may be acquired which contain a great deal of the data on both friendly and "enemy" (mostly former Soviet) equipment. Furthermore, Jim Cook, a civilian contractor in N6 at the Naval Special Warfare Command, has been involved in a project to create a database of detection characteristics for all NSW equipment. Whatever the source of the information, acquiring consolidating, verifying, and entering it into a database will be a time consuming task. It is a task, however, which must be accomplished before a simulation can provide any "real world" value.

#### *b. Management*

As indicated throughout this thesis, manipulation of database entries is a major source of information during mission planning and one of the main strengths of

simulation. It is not difficult to imagine, however, that a database could become a jumbled mess of notional values rather than an accurate depiction of current intelligence. For this reason, database management is crucial.

While it will be up to the individual command to determine the best method of maintaining their database, one suggestion follows. Assuming that simulation is being used at the SEAL Team level for training purposes, and deployed for use by an MPA as required, a master database could be developed and maintained by the N2 at the appropriate Naval Special Warfare Group (NSWG). Copies of this database could be downloaded to individual teams, where a master copy would again be maintained. For each planning iteration, an additional copy of the database could be downloaded for use and manipulation as desired without damage to the original. It is important to remember, however, that the value of an analysis of a mission is minimal if those reviewing it, such as the NSWG, are not privy to the database values used during the analysis.

### 3. Terrain Files

OPLAN/CONPLAN requirements, combined with an intelligence assessment of likely employment possibilities and the commanders vision for the unit will provide the basis for initial terrain file needs. Additional files can be requested through DMA as necessary, but take time to acquire. Advancements in data storage capabilities will undoubtedly allow a command to maintain a library of all desired terrain files.

### 4. Users

While user requirements at any particular command will be dictated by the commander, the following can be used as a guideline for training time. These estimates are based on my experience during the writing of this thesis but are generally agreed with by

experts in the field.[12] Basic proficiency in the operation of a simulation such as Janus can be obtained through an 8 hour course. After this instruction, planners would be able to use the menus present during scenario development and execution, or in short, create and run scenarios. This includes determining the correct terrain, force definition, route planning, indirect fire planning, and so forth. With 40 hours of instruction, a user can become a skilled analyst able to work with post run-data, command and control (CAC) overlays, and most importantly, have a fairly clear understanding of the processes and algorithms present in the simulation.

It may be possible to work with the Naval Postgraduate School in developing such courses of instruction. Whatever the source, the "train the trainer" concept should allow the NSW community to become self supporting in its use of simulation with relatively small time and monetary expenditures.

## C. SOCOM MODELS

Currently, USSOCOM J-5C is developing the Joint Tactical Simulation (JTS). JTS takes the best aspects of several other simulations, the cornerstone being the Joint Conflict Model (JCM), and combines them in a single high resolution simulation. In the development and evaluation of JTS, SOCOM concentrated on four primary areas: Responsiveness; Portability; Flexibility; Usability.

Current scenario development time is too long for SOF purposes. Therefore, SOCOM is looking at a simulation which increases responsiveness. The portability issue will largely be solved with time, as advancements in computer technology allow a simulation such as JTS to be run on a notebook size computer. Flexibility is a primary concern, especially for NSW. In the joint arena of special operations, if a simulation is to prove valuable, it must meet the requirements of each component. Janus, for example, does not

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[12] From a discussion with Bard Mansager, a mathematics professor at NPS and the resident expert in CSM.

model the maritime environment with any detail. JTS, on the other hand, includes water depth, currents, and sea states; aspects which are crucial in most NSW missions. Finally, current simulations are very user friendly. Whether using Janus or JTS, basic operation of the simulation can be achieved in a single day of training.

JTS contains most of the aspects of a SOF simulation which have been identified as important. It is not a two sided simulation, such as Janus, rather it can model up to ten sides. With this capability, all the different factions involved in a conflict such as Somalia can be modeled separately, as well as the civilian population.

Route development capabilities are greatly enhanced. In Janus, terrain does affect the speed of an operator during a patrol. Operators, however, are supermen of sorts, as nothing else affects their speed. JTS uses a fatigue factor to account for this. While it is true that no two operators will fatigue at the same rate, general trends can be determined and modeled and these trends taken into consideration in the analysis of a mission.

Furthermore, JTS models various physical positions and speeds for operators. While all patrols are standing and at the predetermined database speed in Janus, JTS allows crawling, walking, and running, as well as positions including standing, crouching, and prone. This adds a great deal of realism and accuracy to the model and increases the value of the mission analysis it produces.

Routes in JTS will also be more interactive. While a mission is being run in an urban environment, an operator can jump into a building for reconnaissance purposes or cover and concealment. Rules of engagement (ROE) are also being included in JTS. The impact of ROE on a particular mission may be more fully appreciated when a simulation run identifies engagements which resulted in friendly losses due to ROE restrictions.

## D. CONCLUSIONS

The use of computer simulation for mission planning is bound to have both proponents and adversaries. In a community such as special operations, adversaries are

most likely as technology is not viewed by them in the best light. The most common attack received during the writing of this thesis was that the way Janus portrayed a particular part of an operation was unrealistic. For example, the PH and PK values for certain engagement possibilities may follow given values, but in reality they are much different. The response has been to "change them." Simulations are not some magic tool. They consider only the processes and parameters that they are told to consider. If any of these processes or parameters are inherently flawed, they can be changed. That is the power of the system.

The attack that inevitably follows is what about the one exceptional mission where Murphy's Laws are in full effect and fratricide occurs? Simulations are not designed to predict when that will happen. They are based on mathematical models and the laws of probability and predict what could happen given the same circumstances as programmed in the simulation. Since the mission planning process centers around determining these circumstances, simulation should prove valuable. Furthermore, Janus and JTS model fratricide and it would not be difficult to include its occurrence on one percent of all direct action missions, for example, and note the surprising and undesirable affects of its occurrence.

A combat simulation model such as JTS is only valuable if used correctly and will never replace standard mission planning practices or common sense and experience. But the technology exists and is already in use by many operational forces. It may be only a matter of time before the choice to utilize simulation is no longer a choice, but rather a directive. With an understanding of the process and a minimal expenditure of resources, the NSW community can be on the leading edge of the simulation revolution.

## E. RECOMMENDATIONS

If simulation is to gain acceptance in the NSW community at the operator level, implementation will have to be horizontal rather than vertical. Systems placed at the Team level which can be used in any or all of the respects described above will give operators a

chance to learn, evaluate, and innovate uses for simulation themselves. Testing at the staff level has already been conducted by USSOCOM and would prove more effective for NSW if conducted in conjunction with the Teams rather than prior to their introduction to simulation.

There is great potential for the use of simulation in aspects of NSW which have not been addressed, such as riverine operations. Evaluation of tactics, potential locations of detection threats, as well as mission planning, are possible uses for commands such as SBU-26 in Panama. The role of simulation is limited only by the imagination and as special operators are known for their ingenuity, there may be no more appropriate place to employ simulation than in their ranks.

# APPENDIX A. NOTIONAL SCENARIO SITUATION AND TASKING

**Situation**: Country Blue has planned an amphibious assault against the beligerent country Red. The assault force is to commence landing operations at 0400. Country Red's Order of Battle is depicted in Appendix C. The fast-movers launching from the carrier battle group (CVBG) located at grid 350 950 are threatened by the SA-4 site located at 444 993 (See Appendix D for capabilities of SA-4).

**Tasking**: One SEAL Platoon is to launch from the Amphibious Ready Group (ARG) located at grid 350 860 and render the SA-4 located at 444 993 inoperable for a minimum of 12 hours beginning no earlier than 0330 and no later than 0400.

Note:

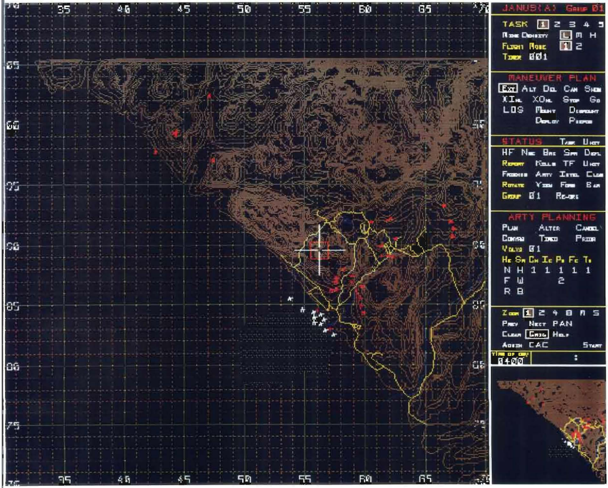
Positions of CVBG, ARG, etc. were intentionally chosen at unrealistic ranges so as to appear on one Janus screen. Just as is true with a topographical map, the larger the size of the area depicted on the screen the less detail shown.

# APPENDIX B. NOTIONAL SCENARIO FRIENDLY ORDER OF BATTLE

Locations of the major elements of the blue assault force are depicted. Reference Appendix C for grid. Carrier launching fastmovers - 350 950. ARG launching SEALs - 350 860. CRRCs in transit - 440 930. Destroyers for NGFS - 420 880 and 520 760. LCACs and AAAVs - 510 800. Helicopter assault force - 430 730.

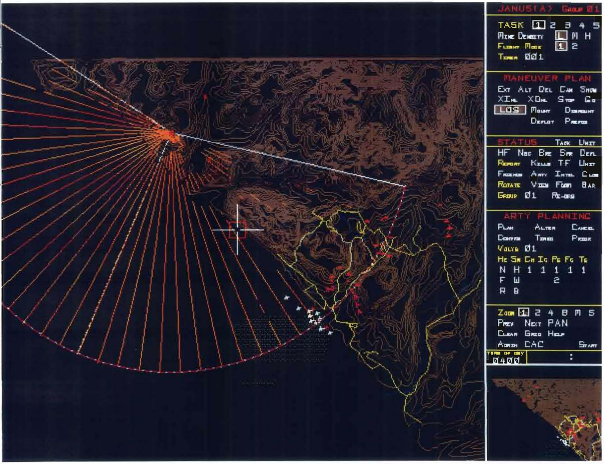
# APPENDIX C. NOTIONAL SCENARIO ENEMY ORDER OF BATTLE

Major red elements are depicted. The concentration of forces including troops, AAA, APCs etc. are located within area bounded by 550 850, 550 950, 700 950, 700 850. The target SA-4 with supporting security element is located at 444 993.



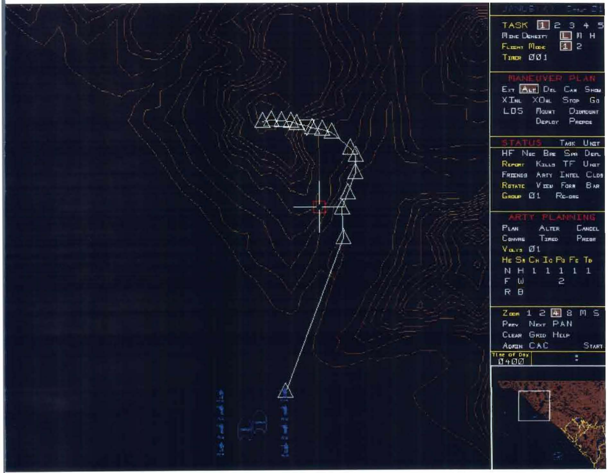
# APPENDIX D. DETECTION CAPABILITIES OF SCENARIO SA-4

The detection and range capabilities of the target SA-4 are depicted including the effects of intervening vegetation.



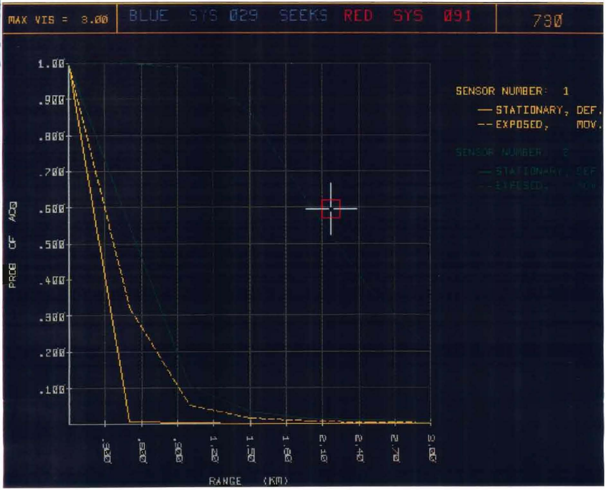
## APPENDIX E. EXAMPLE COA 1 ROUTE

The SEAL element from COA 1 is shown dismounted from the CRRCs. The white line indicates their preplanned route to the target. Triangles indicate a "Go Node", inverted trinagles indicate a " Stop Node", and an inverted triangle with a number underneath would indicate a "Timed Stop Node".



## APPENDIX F. GRAPHIC VERIFICATION

This graph depicts the probability of the blue AW acquiring the red rifleman as a function of range. Sensor 1 is eyeballs, sensor 2 is binoculars. Graphic vierification can be produced for any combination of systems and show sensor or weapon capabilities.



## APPENDIX G. DETECTION

Two four man assault elements are depicted patrolling on preplanned routes. The red bar indicates the location of a red system which has the capability of detecting the blue force at their current location.

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| 3. | The Honorable H. Allen Holmes<br>Assistant Secretary of Defense of SO/LIC<br>The Pentagon RM 2E258<br>Washington, DC 20301-2500 | 1 |
| 4. | GEN Wayne A. Downing, USA<br>Commander in Chief<br>US Special Operations Command<br>MacDill AFB, FL 33608-6001 | 1 |
| 5. | Commander in Chief<br>US Special Operations Command<br>ATTN: Mr. Anthony Normand<br>MacDill AFB, FL 33608-6001 | 2 |
| 6. | The JCS Staff<br>J-3 Special Operations Branch<br>Washington, DC 20318-3000 | 1 |
| 7. | Superintendent<br>ATTN: Professor Gordon H. McCormick<br>(Code NS/Mc)<br>Naval Postgraduate School<br>Monterey, CA 93943-5000 | 1 |

8. Superintendent — 1
ATTN: Professor Bard Mansager
(Code Ma/Ma)
Naval Postgraduate School
Monterey, CA 93943-5000

9. U.S. Army Center for Military History — 1
ATTN: Dr. David Hogan
1099 14th St. NW
Washington, DC 20005-3402

10. Library — 1
Naval War College
Newport, RI 02840

11. Strategic Studies Group (SSG) — 1
Naval War College
Newport, RI 02840

12. Department of Military Strategy — 1
National War College (NWMS)
Ft. Leslie J. McNair
Washington, DC 20319-6111

13. US Army Command & General Staff College — 2
Concepts and Doctrine Directorate
ATTN: Mr. John B. Hunt
Ft. Leavenworth, KS 66027-6900

14. US Military Academy — 1
ATTN: Department of Military History
West Point, NY 10996

15. Marquat Memorial Library — 1
US Army John F. Kennedy Special Warfare Center & School
Rm. C287, Bldg. D3915
ATTN: Mr. Fred Fuller
Ft. Bragg, NC 28307-5000

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| 16. | Jennifer Duncan<br>Center for the Study of Political Violence<br>Naval Postgraduate School<br>Monterey, CA 93943-5000 | 5 |
| 17. | Hoover Institution for War, Revolution and Peace<br>Palo Alto, CA 94306 | 1 |
| 18. | Library<br>Air War College<br>Maxwell AFB, AL 36112-6428 | 1 |
| 19. | United States Special Operations Command<br>ATTN: MAJ Steve Cox, SOJ5-C<br>7701 Tampa Point Blvd.<br>MacDill AFB, FL 33621-5323 | 1 |
| 20. | Hurlburt Base Library<br>16SVS/SVRL<br>ATTN: Susan Whitson<br>410 Cody Ave.<br>Hurlburt Fld, FL 32544-5417 | 1 |
| 21. | USASOC<br>Directorate of History and Museums<br>ATTN: AOHS-Dr Stewart<br>Ft. Bragg, NC 28307-5200 | 2 |
| 22. | Commander, Naval Special Warfare Command<br>NAB Coronado<br>San Diego, CA 92155 | 1 |
| 23. | Commander Naval Special Warfare Development Group<br>FCTCL Dam Neck<br>Virginia Beach, VA 23461-5200 | 1 |
| 24. | Commander, Naval Special Warfare Group One<br>NAB Coronado<br>San Diego, CA 92155 | 1 |

25. Commander, Naval Special Warfare Group Two 1
NAB Little Creek
Norfolk, VA 23521

26. United States Special Operations Command 1
Joint Special Operations Institute
Fort Bragg, NC 28307-5000

27. Mr. Donald R. Hakala 1
2073 Naches Heights Road
Yakima, WA 98908

28. Commander, Special Boat Unit TWENTY-SIX 5
Attn: LT Jeff Hakala
Unit 6102
FPO AA 34061-6102